

Financial Data Analysis: Project

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1 Overview

The course features a project to help the student's understanding of applying the portfolio construction techniques from class to personal and professional investments.

The objective is to evaluate the performance of a quantitative investment strategy using common performance evaluation techniques. The quality of the project will be based on the quality of the analysis, not the performance of the strategy. A well-executed analysis of a strategy that performs poorly is perfectly acceptable.

2 Assignment in Brief

- You have a “primary strategy” allocated to you for this project.
- Explain and analyze your primary strategy as an independent stand-alone investment.
- Evaluate your primary strategy as part of a diversified portfolio consisting of a long value-weighted stock market and long value-weighted bond market portfolio.
- Report your results using a maximum of 5 pages for all text, figures, and tables. Code does not count towards the page limit, but you should strive for succinct and legible code.

3 Assignment in detail

Your project should be structured as 3 sections: overview, strategy analysis, and strategy as part of a diversified portfolio.

3.1 Overview

- Describe the signal used for your primary strategy and briefly explain how it is constructed.
- Explain the economic motivation for why this may be a useful predictor of security returns or risk. Include your own perspective and any relevant outside perspectives (original study authors, famous investors, popular media, etc.).
- Give a preview of the performance of your primary strategy as a stand-alone investment and as part of a broadly diversified portfolio. Does it seem like it should be included as part of an investor's portfolio?

3.2 Strategy Analysis

- Explain the analysis that you will be performing and why it is useful.
- Provide any necessary additional background on the strategy.
- Construct the strategy
 - Sort stocks monthly into terciles based on your signal (Bottom 1/3, Middle 1/3, Top 1/3). Stocks in the “bottom” should be those with the worst expected performance and stocks in the “top” should be those with the best expected performance.
 - Form value-weighted portfolios for each of your terciles. Make sure that returns for these terciles are “excess returns”, meaning returns in excess of the risk-free rate ($r_i - r_f$). The top tercile portfolio is your long-only strategy portfolio.
 - Form a long-short strategy portfolio that is long your top portfolio and short your bottom portfolio.
- Analyze the performance of your long-only and long-short portfolios.
 - Plot cumulative returns for your two portfolios and for the excess returns of the value-weighted stock market portfolio (from the Ken French data, MktRf). The plot should have two panels:
 - * one panel showing cumulative returns for the portfolios.
 - * one panel showing cumulative returns with a constant leverage applied to each portfolio so that they all have an annualized volatility of 10% over the full sample.
 - Create a table to report performance measures for your portfolios for the first half of the sample, the second half, and the full period. For each period report:
 - * What is their average annualized return?
 - * What are their annualized Sharpe ratios?
 - * What are their CAPM and Fama-French 3-factor alphas and t-statistics for these alphas?
 - * What are their information ratios?
 - Discuss these results and what you learn from them. Include a description of prior work on this topic or related topics, how your

findings are similar and how they differ, and your interpretation of these findings.

3.3 Strategy as part of a diversified portfolio

- Explain the analysis that you will be performing and why it is useful.
- Form mean-variance optimal diversified portfolios for your strategy; one version using your long-only portfolio + other assets and another version using your long-short portfolio + other assets.
 - The other assets in your mean variance portfolio must include the Vanguard Total Stock Market ETF (VTI) and the Vanguard Total Bond Market ETF (BND). These two ETFs are sufficient, but you may add other assets (e.g., other trading strategies) if you like. For long portfolios, make sure that you are using excess returns.
 - Use the full time-period to estimate average returns, variances, and covariances of all assets. For means and variances, use all available data for that asset. For covariances/correlations, use the mutually overlapping time period (e.g., if one asset has data starting in 2000 and another starting in 2005, estimate the covariance or correlation from 2005 onward).
- Form comparison diversified portfolios. You must form a 60/40 portfolio that is invested 60% in the Vanguard Total Stock Market ETF (VTI) and 40% in the Vanguard Total Bond Market ETF (BND). You may add other comparison portfolios if you wish, but this is not required.
- Analyze the performance of your mean-variance efficient portfolios and your comparison diversified portfolio or portfolios.
 - Plot cumulative returns. The plot should have two panels:
 - * one panel showing cumulative returns for the portfolios.
 - * one panel showing cumulative returns with a constant leverage applied to each portfolio so that they all have an annualized volatility of 10% over the full sample.
 - Create a table to report performance measures for the portfolios over the full period:
 - * What is their average annualized return?
 - * What are their annualized Sharpe ratios?
 - Discuss these results and what you learn from them. Is your strategy worth including in a diversified portfolio? How does the relatively short time period (~20 years) affect your conclusions?

4 Written project style guidelines

A highly professional writing and document presentation style is mandatory. If you are using F# formatting for literate scripts or notebooks, the default

formatting is fine. If you use Microsoft Word, use 1-inch (2.5 cm) margins, 1.5x line spacing, and Times Roman 11 point font. The entire project must fit in the page limits, including including all charts, graphs, footnotes, and so on.

I know it is hard to keep the project within the length limits—that is part of the challenge. It is important to convey content in a succinct and impactful way. The goal of the written project is a succinct paper that you could submit to your investors, clients, job interviewers, etc. that summarizes everything relevant. If you can clear that hurdle, then you may get time for more detail with those key stakeholders.

To be effective, each report must exhibit an informative and engaging writing style. This is necessary to sell one's ideas. For some invaluable tips on how to improve writing style, consult an expert.¹

5 Reference Citation Policy

Students are encouraged to use anything and everything they can get their hands on to help in their project. But remember that this project represents original independent work. Plagiarism is strictly forbidden.

Plagiarism includes any aspect of claiming the work of others as your own. This includes copying material without proper acknowledgment, supplying a proper citation but leaving out quotation marks, and paraphrasing materials without proper citation. Your paper will be checked for plagiarism to ensure compliance with this rule.

Document original sources of information using complete and informative footnote citations. The purpose of footnoting is to help the reader assess the writer's independent contribution and to make it easy for the reader to consult original sources. If you benefited from the helpful comments or editing input of others, thank them in your first footnote. Other footnotes will cite factual sources of information.

For citations, author, article title, publication title, date, and page numbers are all key components of a useful citation. See the following footnote for an example.² If you have any questions about citation style consult the Chicago Manual of Style.

¹Twain, Mark, *Cooper's Prose Style*, in Bernard De Voto, ed., *Letters From The Earth*. Greenwich, CN: Fawcett Publications, Inc., 1938: 117-124. Strunk Jr, William, *The Elements of Style*, 1918. King, Stephen, *On Writing: A Memoir of the Craft*, 2000.

²Cliff Asness provides sobering back of the envelope math for how likely it is for a positive alpha strategy to underperform for 1, 5, and 20 years, "Little things mean a lot," September 15, 2017 (<https://www.aqr.com/Insights/Perspectives/Little-Things-Mean-a-Lot>).